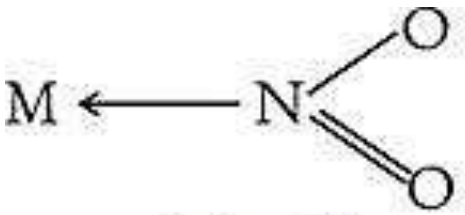
Ligands

- The molecule or ions which are coordinated to the metal atom or ion.
- Eg. $K_4[Fe(CN)_6]$, the **6 cyanide group** coordinated by Fe^{2+} and are the ligands.
- **Ligand can be negative ions, positive ions or neutral molecules**.
- Ligand are **lewis base**.
- **Central metal** atom or ion is **lewis acid**.

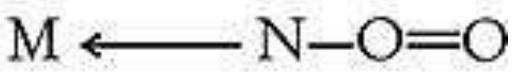
Type of ligands

1. **mono** or **unidentate** ligands
2. Poly or **mutlidentate** ligand
3. **Ambidentate ligands:-**

If a ligand has **2 or more donor atoms**, complex is formed only **1 donor** atom is attached to the metal.



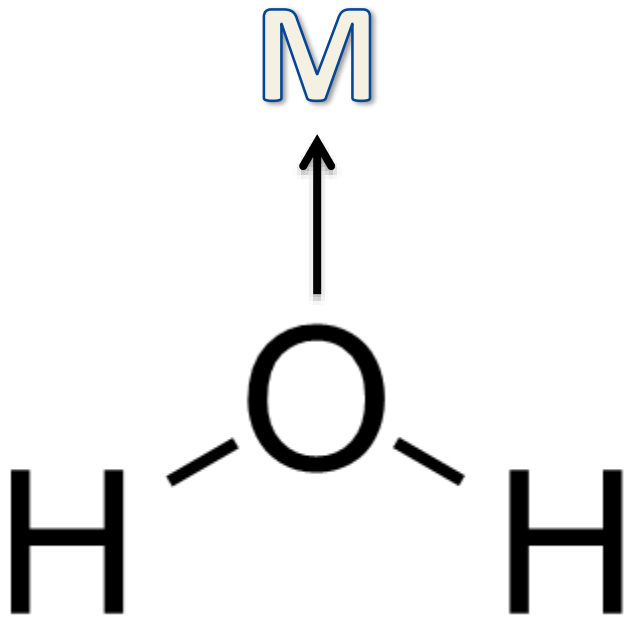
nitrito–N
(In yellow complex)
I



nitrito–O
(In red complex)
II

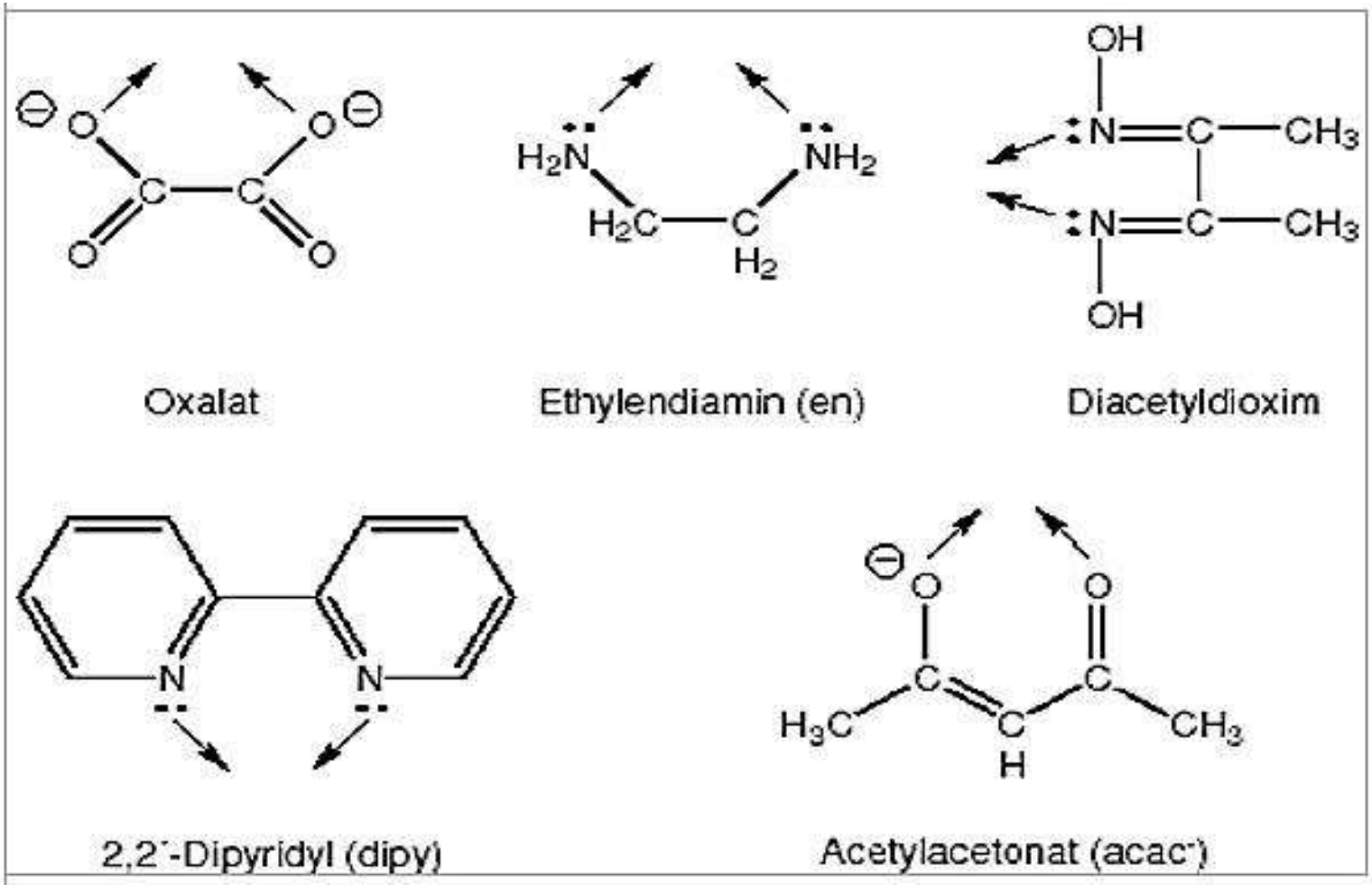
1. mono or unidentate ligands

- one donor atom or **one point of attachment** and can coordinate with the metal ion at only one site in a complex.
- Eg. Cl^-, NH_3,H_2O etc.



2. Poly or mutlidentate ligand

2 or more donor atom or points of attachements.**Polydentate** ligands are further classified as bi, tri,…..hexa dentate.



Coordination Number

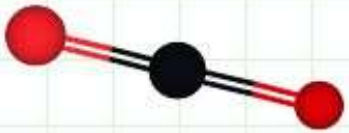
CN - Number of ligand atoms bonded directly to the central metal ion.

Specific for given metal ion in particular Oxidation #.

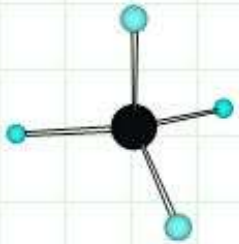
i.e.,	$[Co(NH_3)_6]^+$	CN = 6	Ligand # = 6
	$[Ag(NH_3)_2]^+$	CN = 2	Ligand # = 2
	$[Co(en)_3]^+$	CN = 6	Ligand # = 3

Geometry of Complex is related to CN.

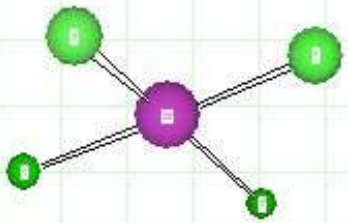
CN = 2 Linear



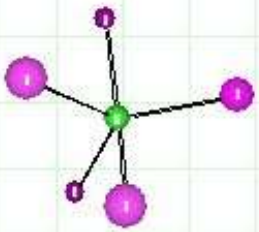
CN= 4 Tetrahedral (d^{10})



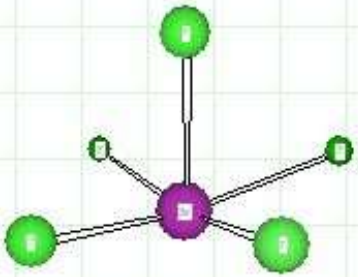
Sq Planar (d^8)



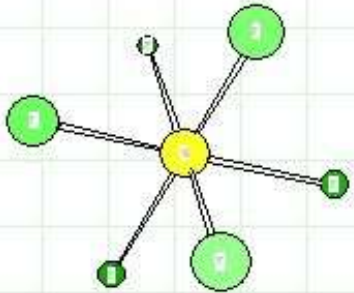
CN = 5 Trigonal bipyramidal



Square Pyramide

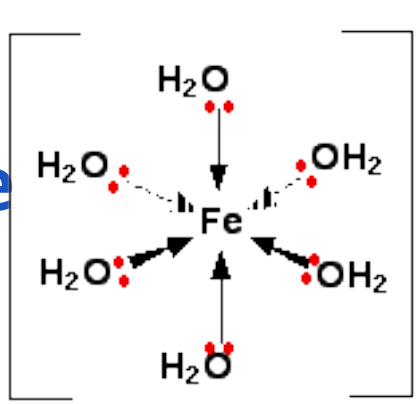


CN = 6 Octahedral

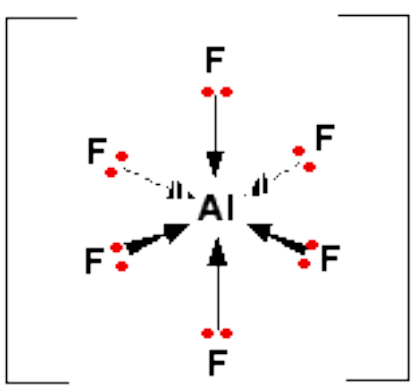


Complex ion

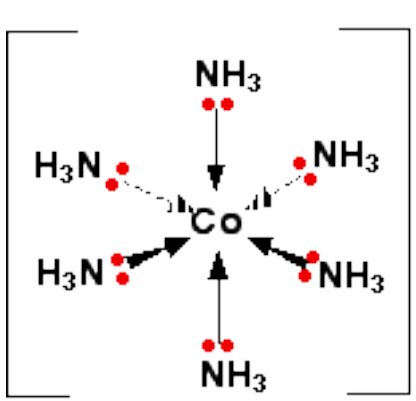
A **complex ion** has a metal **ion** at its **Centre** with a number of other molecules or **ions surrounding** it.



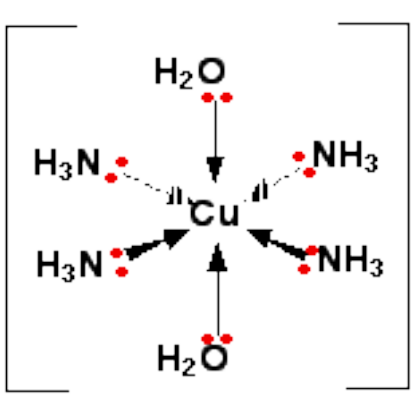
[$Fe(H_2O)_6$]$^{3+}$



[AlF_6]$^{3-}$



[$Co(NH_3)_6$]$^{2+}$

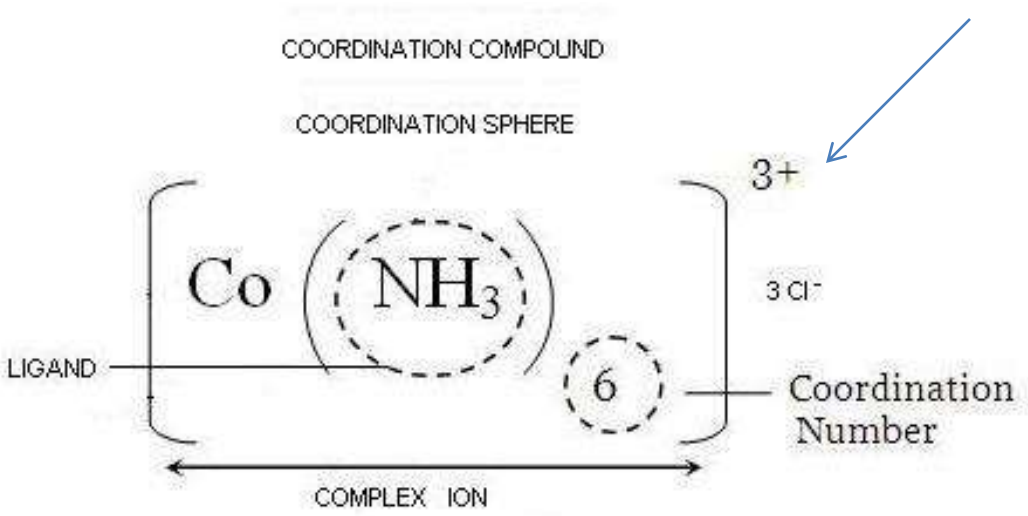


[$Cu(NH_3)_4(H_2O)_2$]$^{2+}$

Coordination entity

- Metal atom or **ion bonded** to fixed number o ions or molecule. For eg.
- $[CoCl_3(NH_3)_3]$ fixed Cl and NH_3 ion.

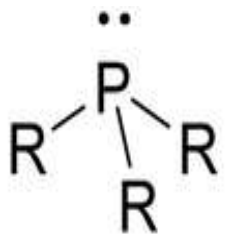
Coordination sphere



oxidation no.

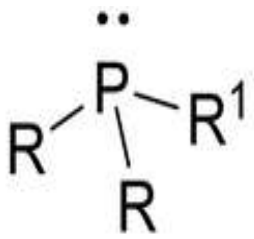
Homoleptic- one kind of donor grp attched to metal ion or atom.

a)



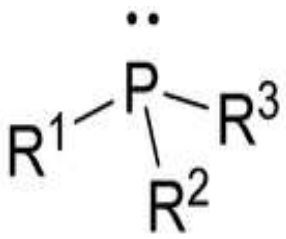
Homoleptic

b)

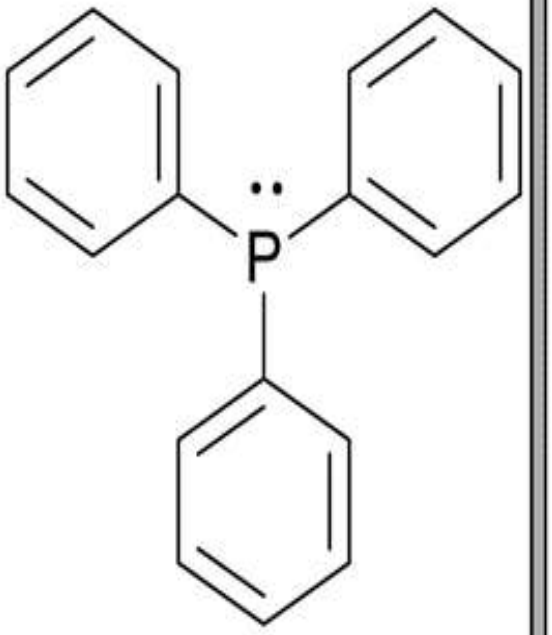


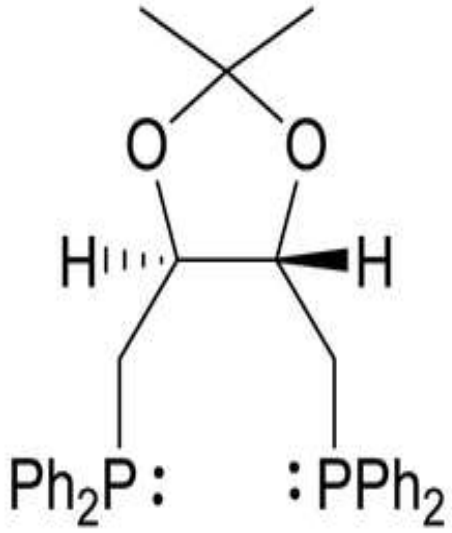
Heteroleptic

c)

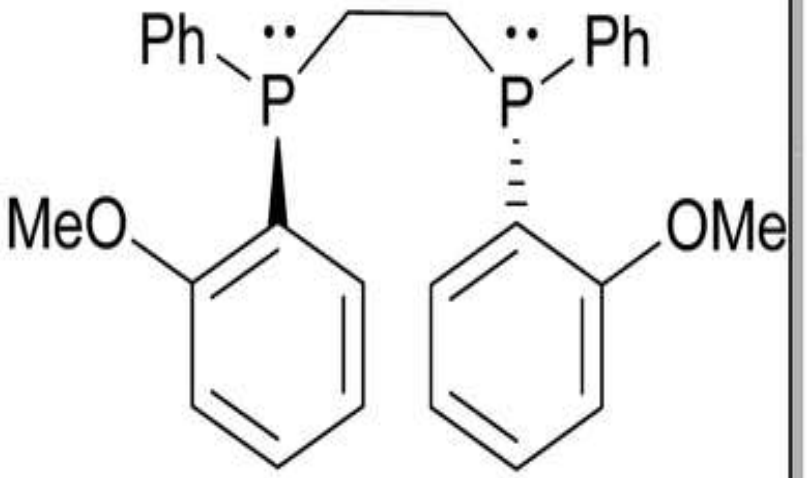


Asymmetric





(+)-DIOP



(-)-DIPAMP

Charge number of complex ion

- The **net charge carried by complex ion**.

Charge number of $[Fe(CN)_6]^{4-}$

= charge of Fe^{2+} + 6 x charge on CN^- ion

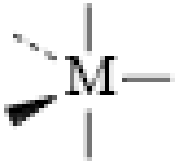
= +2 + 6 (-1) = - 4.

Coordination polyhedron

The spatial **arrangement of ligand atoms**, directly **attached to the central atom/ion**.

Square planar

Tetrahedral



Trigonal bipyramidal

Square pyramidal

Octahedral